

MFG502674

# Product Visualization Workflow from Inventor to 3ds Max to the Client

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## Learning Objectives

- Discover the connection between Inventor, and 3ds Max for an optimal design workflow.
- Learn how to import an Inventor model into 3ds Max 2023 for use with the Arnold renderer.
- Learn how to create and configure scene materials and lighting.
- Learn how to place cameras and create animations for the final design.

## Description

In the real world, one program just can't do it all. Sketching, massing models, final design, animation, and rendering of engineering models—this class will discuss the workflow for using multiple Autodesk products in a production environment. Discover the ins and outs of this workflow, starting with a sketch, moving to Inventor software for final design, then finishing with 3ds Max software and Arnold to render the final animation. Learn how Autodesk Drive can help manage the workflow files, review the Inventor-to-3ds-Max import process, and see how to render photo-quality images. We'll cover how to use Arnold materials and lights to light the scene and composition to create compelling images. And we'll show you how the Camera controls can adjust the scene exposure and depth of field. Get ahead of the competition by learning to create your renderings using photographic composition in a streamlined workflow.

## Speaker

I've been an animator and trainer, teaching 3d Studio and 3ds Max since 3d Studio DOS R3. Over the years, I've had the opportunity to work as a designer, an animation lead for a simulation and training developer and as a Kinetix Training Specialist (changed to Discreet, then Autodesk). As an Autodesk Training Specialist, I delivered 3ds Max training for a variety of clients, was a writer for the certified courseware that shipped with 3ds Max releases 3 through 10 and was a developer of the Autodesk Certified Instructor program. As a trainer, I had the privilege to train thousands of class attendees from the basics to highly focused, advanced 3ds Max training. Working with clients like Disney, Boeing, Ration, and others, in industries as diverse as architecture to military to textiles and automotive marketing. Today I am the CEO of Spectra3D Technologies, a 3D printing provider based in Asheville, NC.

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## Introduction

As a designer or engineer, you can use Autodesk's Inventor software to create buildable designs for anything from simple parts and sculpture all the way to highly complex mechanical assemblies. There are many times when it is helpful to see a design animated and rendered in an environment like where it will be placed.

Visualization using an animated camera is a tool for showing off a design in a way that still pictures and diagrams cannot convey. 3ds Max is the ideal environment for animating and rendering of Inventor designs. You can import your Inventor design directly into 3ds Max. Once imported, you can place it in a premade environment, animate the model, apply materials, and render the scene.

Presenting a compelling animation involves being able to coordinate the animation of multiple objects within the same scene. Once the animation is complete, you need to decide what the output will be for the animated sequence.

An animated sequence can be rendered directly to a video file that can be played back at full speed. However, it's often better to render out to a sequence of files that can be turned into a video file later.

The level of quality of final rendering will usually be based on certain requirements. If you're running a test to see if the animation looks the way you want it to, you can save a preview rendering of the viewport. When it comes time to create your final rendering, Arnold can create a high-quality realistic rendered animation.

This class will discuss and outline the steps you would take to go from an Autodesk Inventor design file to a fully rendered animated sequence using 3ds Max 2023 and Arnold.

## The Project

This project is a prototype development for a set of folding pet steps called Hide-a-Paw™. The design has been patented and the developer was looking for a lightweight, 3D printed functional prototype, along with the 3D CAD file and drawings to take to investors and manufacturers.

## The prototypes

Early designs and prototypes of the pet steps were hand made over the course of several years. The first functional prototype was made from sheet steel. Needless to say, this was very heavy and cumbersome to use, but it showed that the idea could work.





*A VERY HEAVY, STEEL FIRST PROTOTYPE.*

The second prototype was more refined and based on some discussions of the best approach to designing this as a viable product. The second prototype was made from wood but used steel brackets. While it was much lighter, it was still too heavy for commercial use. So, the decision was ma

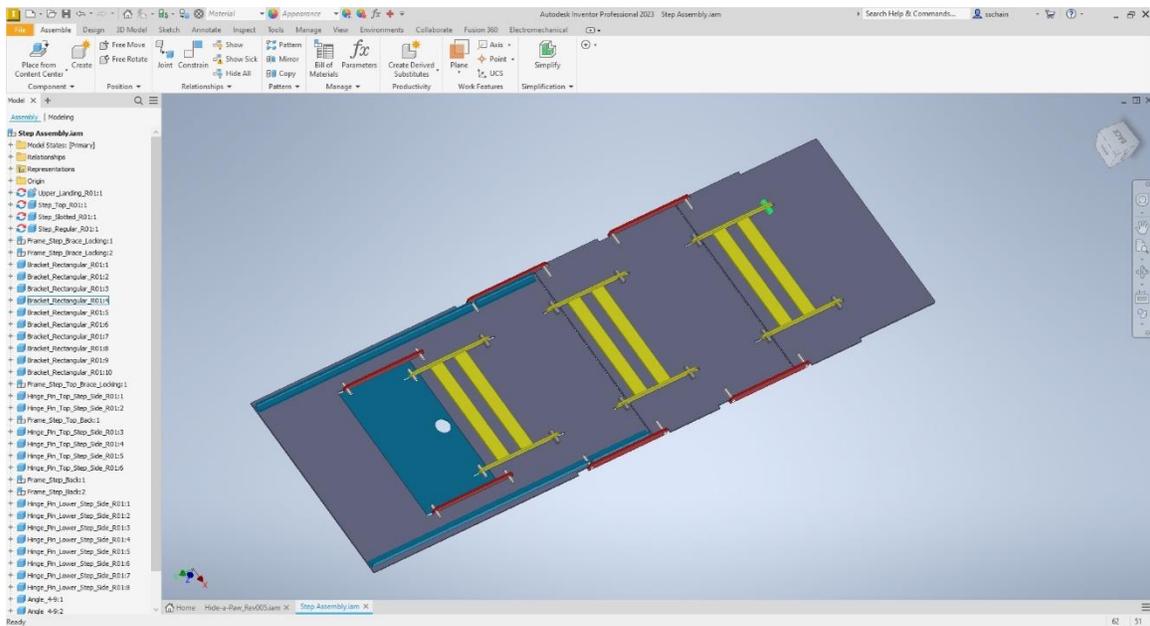




*THE SECOND HAND-MADE PROTOTYPE OF THE HIDE-A-PAW™ PET STEPS.*

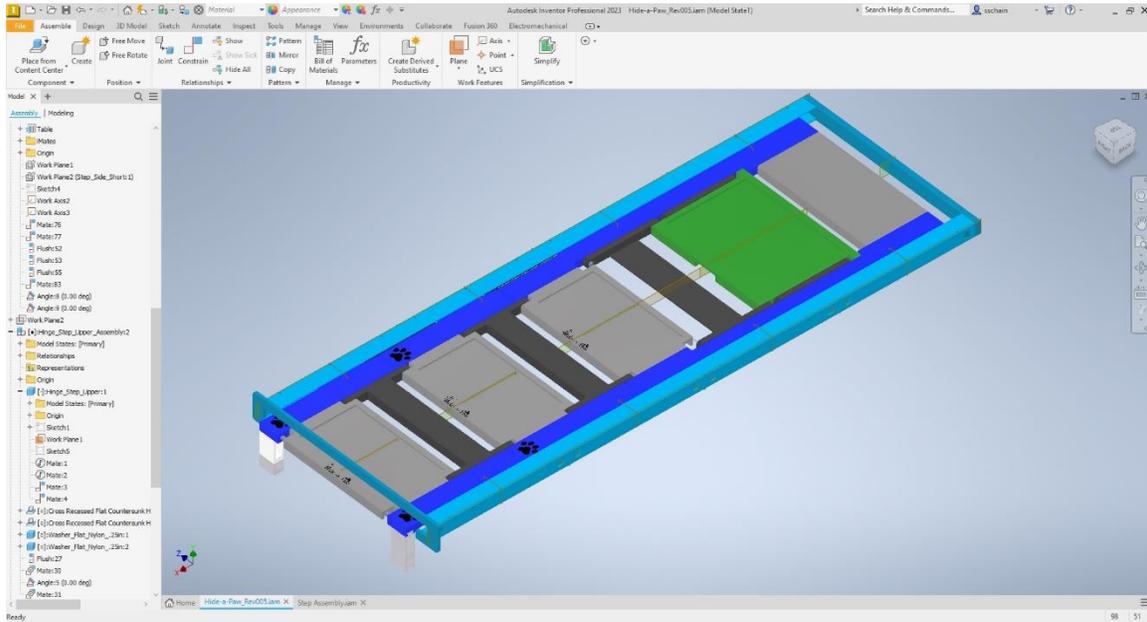
## Creating the Hide-a-Paw™ Assembly

The plan was to create the design using Autodesk Inventor, beginning with individual parts, then create an assembly from those parts.



*THE FIRST STEEL PROTOTYPE AS DESIGNED IN AUTODESK INVENTOR.*

When the first prototype was created in Inventor, we did an initial review with the client. Out of that review, the second wooden, handmade, prototype was created. It was from that prototype that we moved forward with the final design in Inventor for the 3D printed functional prototypes and for use in promotional animations.



*THE FINISHED DESIGN IN INVENTOR, READY FOR 3D PRINTING AND ANIMATION IN 3DS MAX.*

Once the design is complete in Inventor, it's time to switch over to 3ds Max. Here, I'll set up a project folder and start developing the visualization for the Hide-a-Paw assembly.

### Setting the Project Directory

Before doing anything in 3ds Max, it's important to configure a project path. There is a default project directory setup that I'm going to use for this animation. (If you don't work with project directories, I highly recommend using them, as it's a very good way to organize individual projects.)

1. In the application menu, choose **Project > Set Active Project**.
2. Navigate to the **MFG502647 - Viz 3ds Max Project** directory and select the folder as the current project directory.

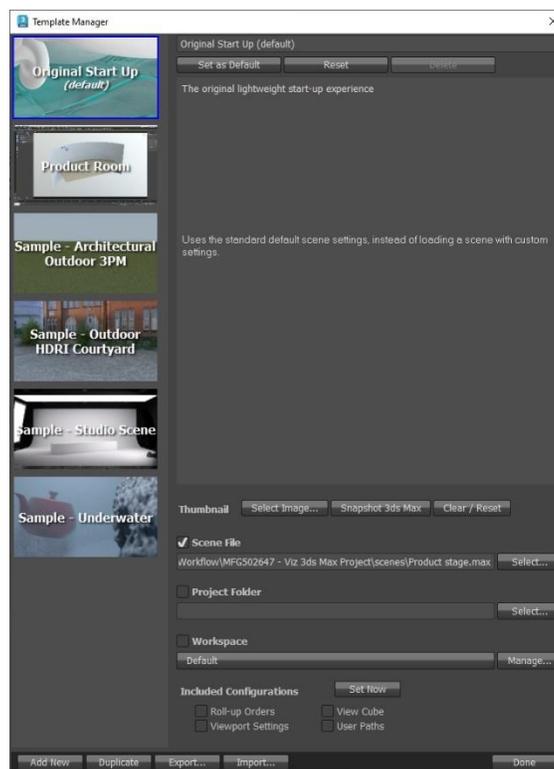
Now, when you load and save files, you can save them to the scenes directory within that project folder.

## Loading a Default Scene

Starting with a scene that has lighting and a background already in it saves time when visualizing a design. Furthermore, it is good practice to have several pre-built environments that you can use for rendering product designs. These environments are pre-lit and pre-textured, making it easier to focus on the product you are animating and rendering.

Using preconfigured environments is optional, but if your goal is to render a high-quality animation of an Inventor assembly, it's helpful to use a pre-built file that has many of the settings already configured. That's not to say you won't have to make any changes, but it gives you a good starting point.

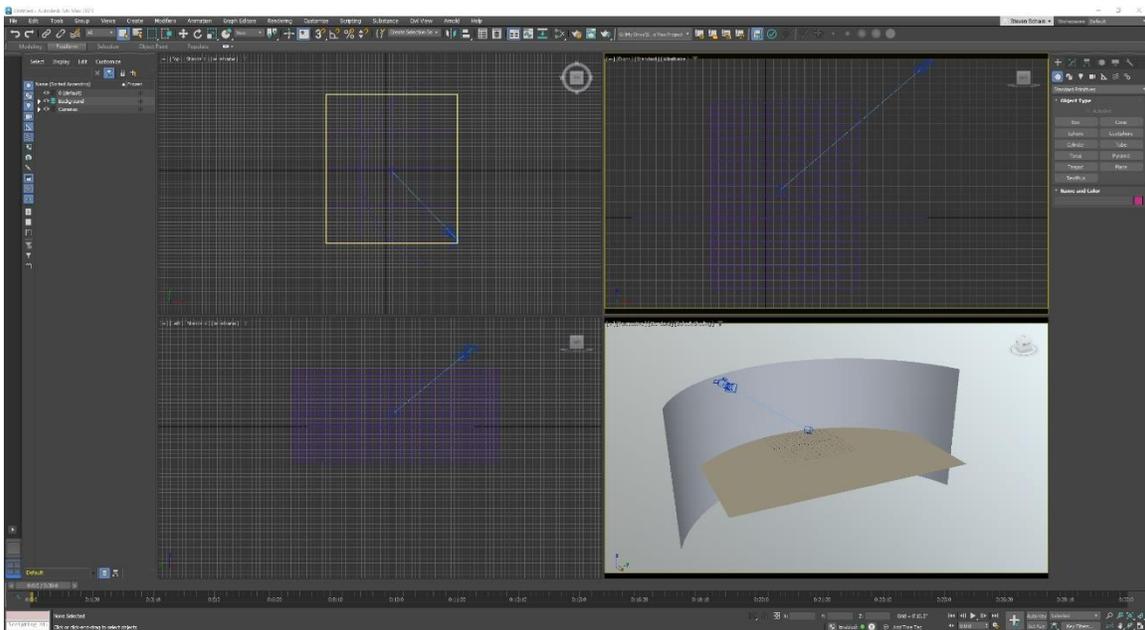
One way to setup new scenes is using the Template Manager to create a new template you can use as a starting point.



*YOU CAN HAVE SEVERAL PRE-BUILT ENVIRONMENTS THAT YOU USE FOR RENDERING DESIGNS. THESE ENVIRONMENTS ARE HELPFUL BECAUSE THEY CAN BE PRE-LIT AND PRE-TEXTURED.*



*USING THE NEW FROM TEMPLATE OPTION TO CREATE A NEW SCENE.*

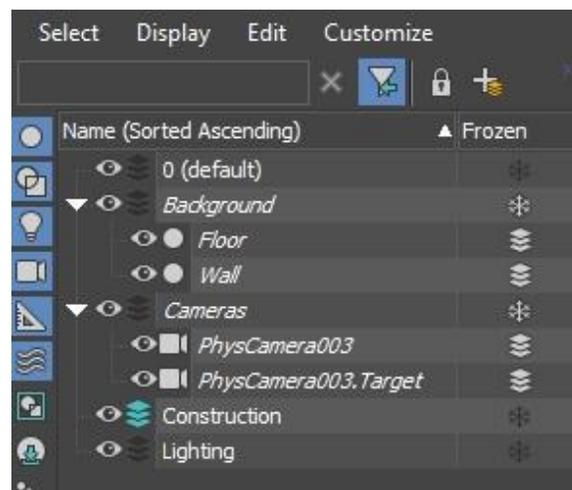


*THE NEW SCENE IS CREATED WITH THE PRESET ENVIRONMENT.*

## Layers

Another reason to start with a preconfigured scene is because you can have some layers preset that help to isolate the lighting and cameras, as well as the background and construction objects.

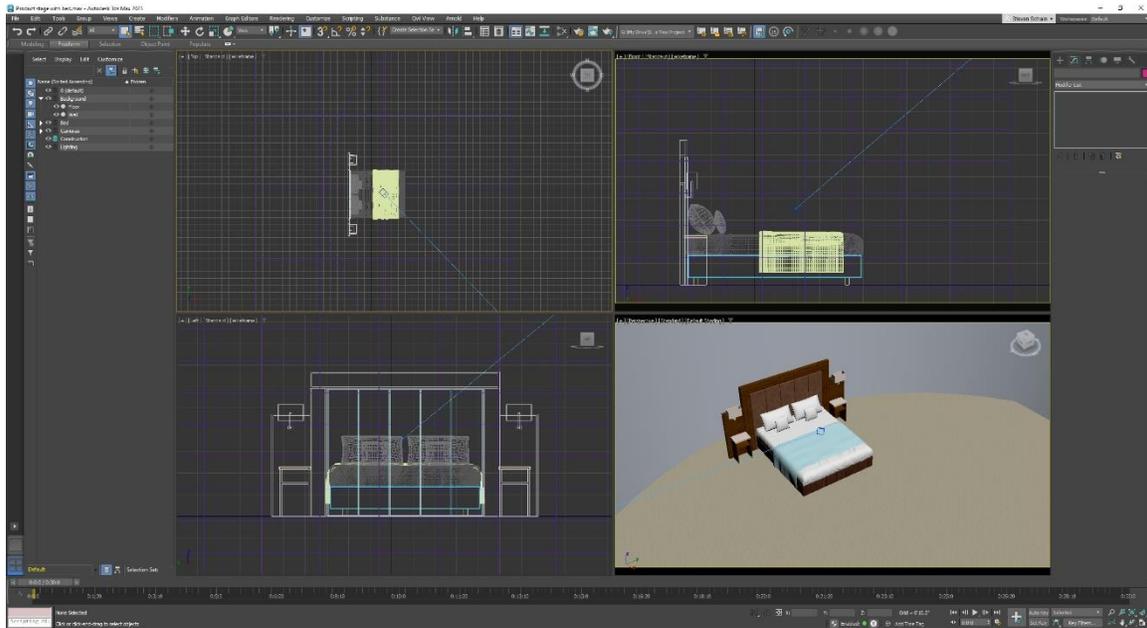
Looking at the Layers dialog for this project's starting file, you'll see that I have a Background layer, a Cameras layer and a Lighting layer. Also notice that the Background and Cameras layers are frozen, which means that I cannot pick them in the viewport.



*THE SCENE EXPLORER CONFIGURED TO SHOW THE AVAILABLE LAYERS.*

The advantage to working with frozen layers is that you don't have to worry about accidentally selecting the background objects or moving cameras. And notice there is also a construction layer that's the current layer, so anything you build will be created on that layer. If I want to animate one of the cameras that are in the scene, I can unfreeze the layer and animate it.

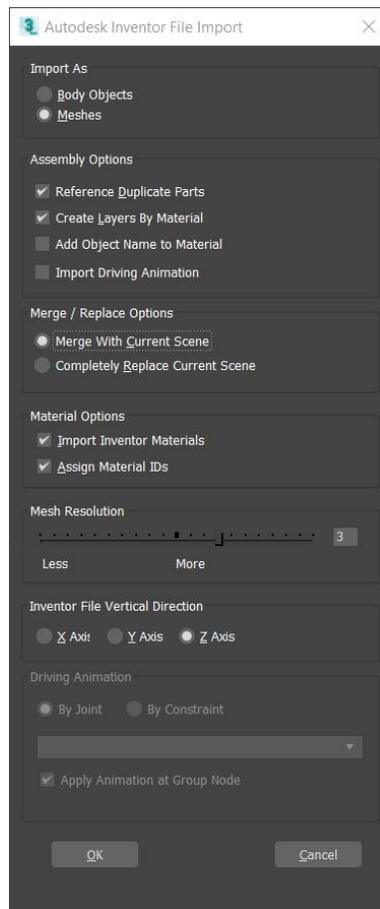
Once the initial scene is created, I can import any other models I want to use. In this case I am using a bedroom set with for the final animation.



*THE SCENE IS SETUP WITH THE MODELS NEEDED FOR THE ANIMATION.*

## Importing the Assembly

3ds Max allows you to import Autodesk Inventor files, whether they are parts (IPT) or assemblies (IAM). These objects still keep the naming they have been given in Autodesk Inventor and are imported as one of two types of objects: a Body Object, or an editable mesh. Once the file(s) have been imported, they can be edited, just like any other model in 3ds Max.



*THE AUTODESK INVENTOR FILE IMPORT DIALOG BOX.*

## Import Settings

The first thing to choose when importing is to decide whether you're going to work with Body Objects or Meshes in 3ds Max. These objects work in completely different ways.

A *body object* is an ACIS solid model that maintains the solid features from Autodesk Inventor. Body objects are unique in that the render resolution and the viewport resolution can be adjusted to fit your needs. It is completely possible to use a body object for both a very high-resolution, rendered animation, and low-resolution, real-time simulation geometry.

A *mesh object* is a polygon mesh surface that's generated from the imported data. The quality of the mesh is determined by the mesh resolution option towards the bottom of the dialog. Once

you import an Inventor file as a mesh, you don't have the ability to change the resolution of the geometry.

After that come the Assembly options. These three possible selections allow you to reference duplicate parts, create layers based on the material, and add an object name to the material. When the **Create Layers By Material** option is enabled, layer names are generated by material, and all objects with that particular material are placed on that layer. This can be helpful for organizing your scene.

Depending on how you want to organize your scene will depend on whether or not you enable **Add Object Name to Material**. This option will use the imported material name in the name of the object. Be aware that when importing Autodesk Inventor files, some of the object names may be very long. While most will be based on the object name, keep in mind that some of the standard hardware can have very long names. But overall, naming shouldn't be too much of an issue, as long as your Inventor file is logically named.

The **Merge and Replace** option is, simply put, whether you want to merge the objects together in the current scene or replace the scene with the imported file.

The **Material Options** allow you to import the materials straight from Inventor; this does, however, come with its issues, as not all Inventor materials have a direct correlation to materials in 3ds Max.

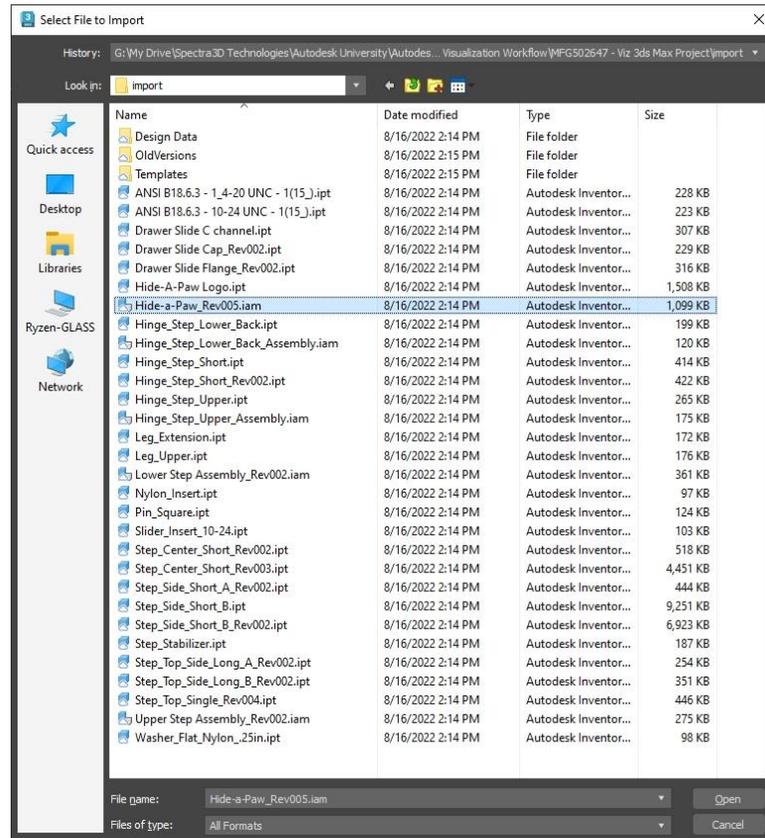
The last options are whether you want higher or lower mesh resolution (if you imported Inventor files as Mesh objects), and a choice of the vertical direction to be on the X, Y, or Z axes (typically left on the Z axis).

## Importing the Inventor Assembly

1. From the **File** menu, click **Import > Import**.
2. Open the **Import** directory.
3. You can see both part files and assembly files in this directory.

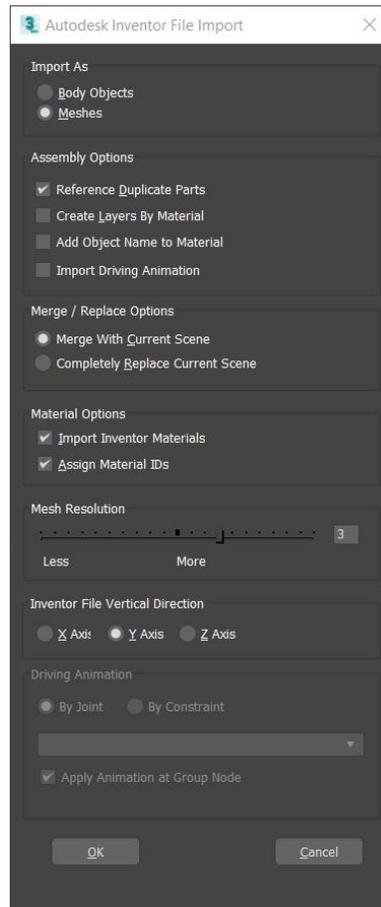
*I've made it a little bit easier because I've moved everything into one directory. 3ds Max will resolve links within an assembly file, as long as the directories for all of the parts are accessible and do not differ from the computer that this was designed on.*

4. Select the "**Hide-a-Paw\_Rev005.iam**" assembly file, and then click **Open**.



*THE SELECT FILE TO IMPORT DIALOG BOX SHOWING THE HIDE-A-PAW™ ASSEMBLY AND PART FILES.*

When you click **Open**, you're presented with the import dialog box:



5. Select **Import As: Meshes**.

*There's a little bit more computer overhead required when you use body objects because they are ACIS solid geometry, and the polygons have to be calculated for the surface. This is a primary reason meshes are used, as opposed to body objects. The mesh object is lighter and doesn't require the same amount of computer overhead.*

6. In the **Assembly Options** group box, keep **Reference Duplicate Parts** enabled and uncheck **Create Layers by Material** to disable it.

*When Create Layers by Material is checked, the importer will create the layer for each material in the assembly. In this case, there are only three objects which will be added to a new layer once they are imported, so there is no need for layers based on materials.*

7. In the **Merge/Replace Options** group box, enable **Merge with Current Scene**.
8. In the **Material Options** group box, enable both the **Import Inventor Materials** and **Assign Material IDs** options.

*This will cause 3ds Max to use the materials assigned to each part inside of Inventor. This makes it much easier to edit materials on each object, since it is already assigned.*

9. Set the **Mesh Resolution** value to **3**.
10. Lastly, set the **Inventor File Vertical Direction** to the **Y Axis** option.

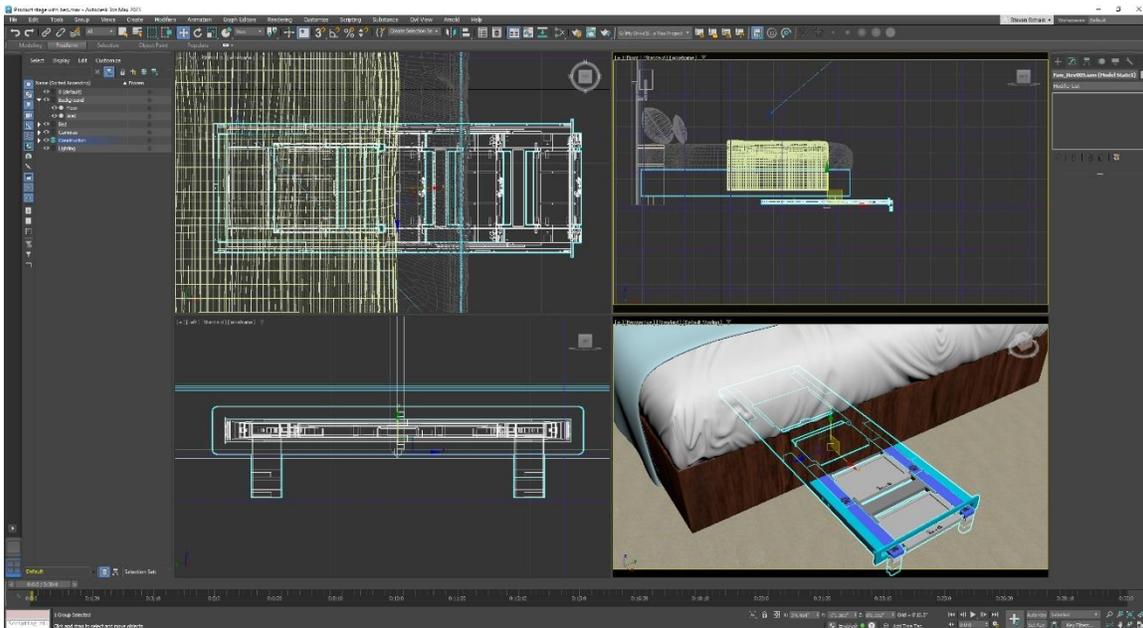
*By setting the vertical direction, you are indicating which direction is up in the Inventor file. This will import the geometry with the orientation adjusted to compensate for the fact that the Y axis is the Up axis in the current assembly file.*

11. Click **OK**, and the import process will begin.

3ds Max will take some time to process the assembly and create the individual pieces of geometry.

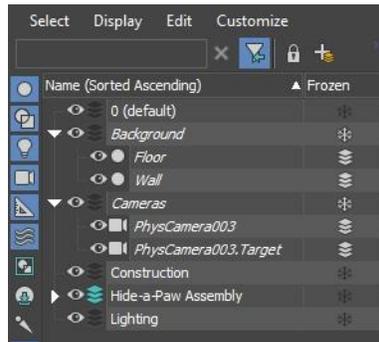
Once the import process is complete, the assembly will be placed where it was built within Autodesk Inventor.

*Note: One additional—and important—thing to understand is that you can build multiple assembly files, and if you place them all relative to each other, they will import into 3ds Max in the proper location.*



*THE ASSEMBLY SHOWN AS IT IS IMPORTED.*

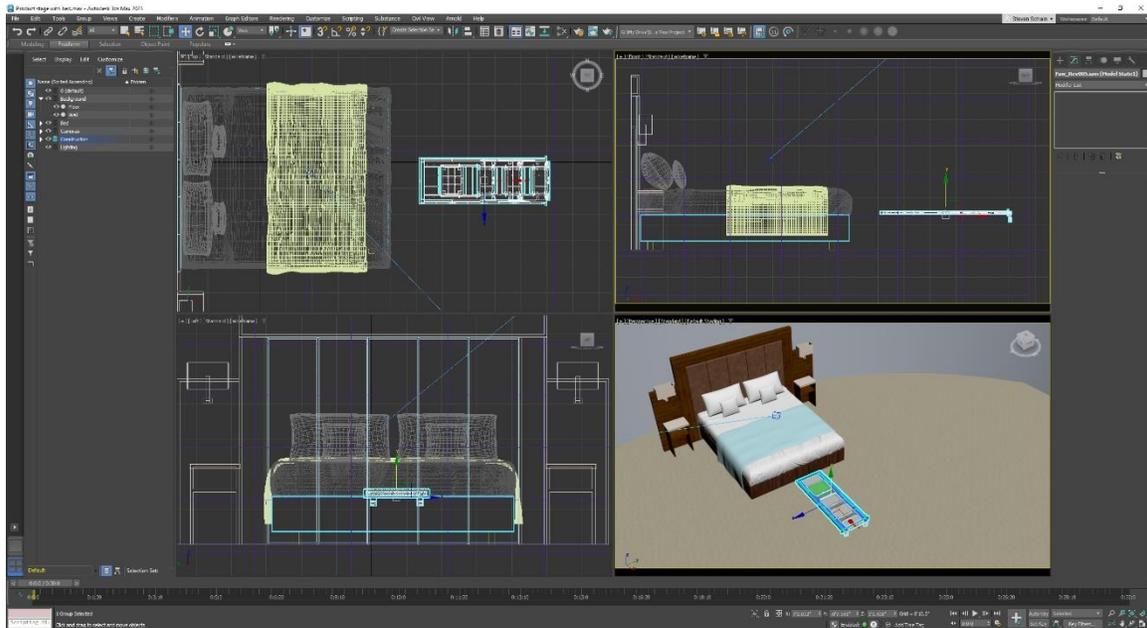
Once the assembly is imported, I can create a new layer, and assign the models to that new layer.



*THE MODEL PARTS ASSIGNED TO A NEW LAYER.*

## Repositioning the Assembly

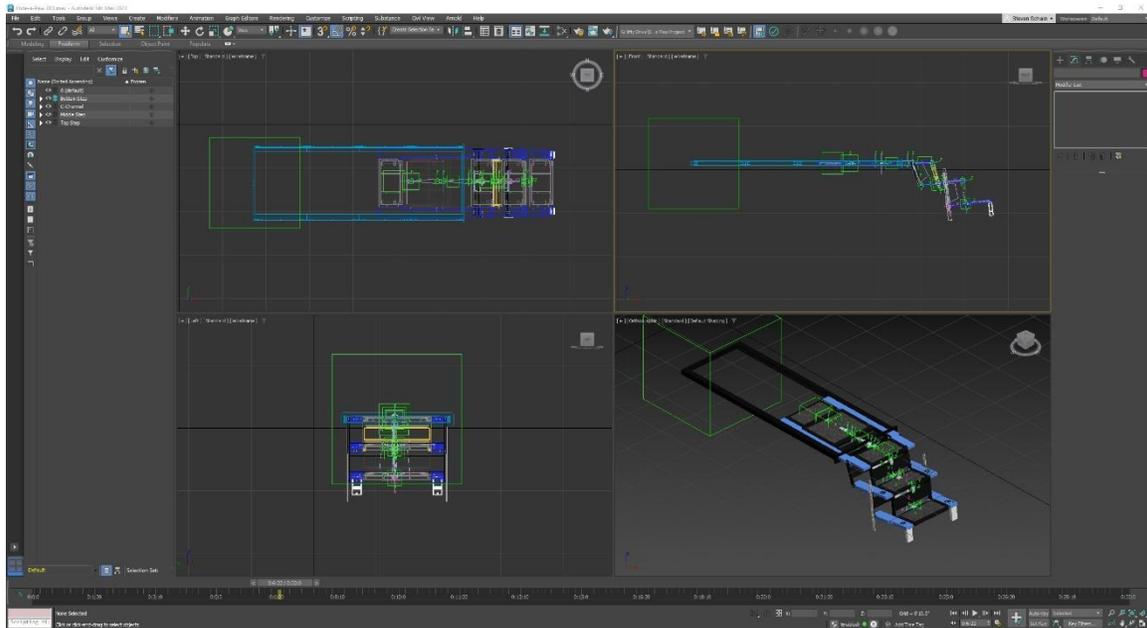
The assembly was imported from Inventor; however, it is not positioned the way I would like for the current scene. The assembly comes in as a group and is easy to move by simply clicking on the model in the viewport and moving it to the correct location.



*THE ASSEMBLY POSITIONED WITHIN THE SCENE.*

## Animating the Assembly

One of the benefits of working with 3ds Max is the ability to create detailed animations of inventor assemblies. The steps need to be shown opening and lowering to the floor as part of the animation. This was done using a combination of traditional keyframe animation, and several IK setups to form a functional rig for the assembly.



*THE ANIMATED ASSEMBLY.*

## Working with the Camera

At this point, I'm going to set up a simple camera animation that takes the currently viewed camera, which is camera02, and moves it from one side of the scene to the other. Then I'll create a second camera that zoom in to the logo. Using a second camera allows me to edit the two sequences together later and adjust the timing of the transition.

When setting up the animation, the first thing to do is to set up your frame rate. For example, if the animation is going to be for film, it will need to be set at 24 frames per second. However, if it is for video, then it will need to be set at 30 frames per second. After that, the length of the animation, as well as the start and end times, will be needed to be set.

I'm doing a simple camera move while the assembly is animated, so I want to make sure I have enough time to see it. Remember—this is going to be shown to a client, so you don't want it to go by too quickly. Will 10 seconds be enough time, or will I need to make the length 30 seconds? Determining this ahead of time will avoid issues that can occur if you must retime an animation later.

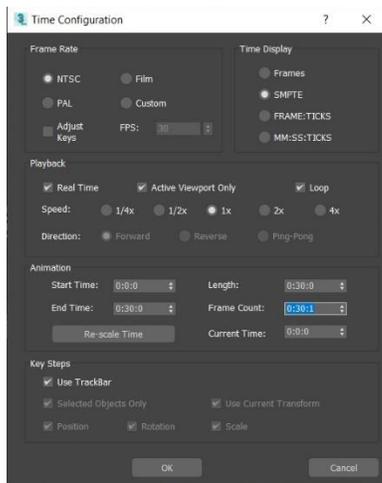
To animate a camera, I can either use keyframes or place the camera along a path, if I need a more complex camera animation. Here, I'm going to move the camera around the scene to get the best view of the animation over a period of 30 seconds.

## Creating the Keyframes

1. In the **Top** viewport, select **camera02**.

*Before I start creating key frames; I'll set the length of the animation.*

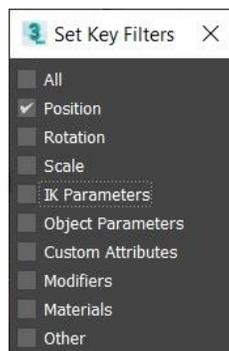
2. Open the **Time Configuration** dialog. 
3. In the **Animation** group box, set the **Length** to **30 seconds**.



4. Click **OK** to close the dialog.

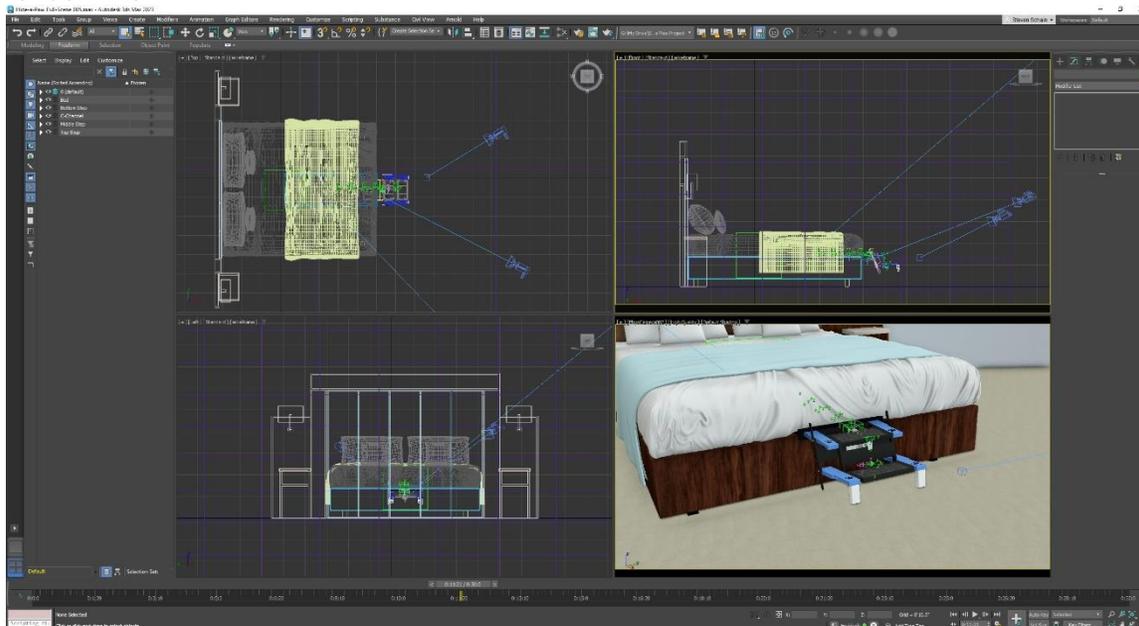
Once I've set the length of the animation, I'll use the Auto Key option to animate the camera from frame 0 to 30 seconds.

5. Turn **ON** Auto Key. 
6. Click the **Key Filters** option. 
7. In the **Set Key Filters** dialog, enable only the **Position** option (uncheck/disable **Rotation**, **Scale**, and **IK Parameters**).



I ONLY WANT TO BE CREATING POSITION KEYFRAMES.

8. Drag the **Time Slider** to the first keyframe.
9. Use the **Move** tool to move the camera to the first location.
10. Repeat the process until all the keyframes have been created.
11. Scrub the Time Slider to see in the camera viewport what the animation is going to look like.



*THE SCENE, AS VIEWED FROM THE CAMERA DURING THE ANIMATION.*

12. Turn **OFF** Auto Key.

The idea here is not to create the final version of the animation; rather, it's to rough it in. Later, I can edit it using the Curve Editor and the Dope Sheet, if I so choose.

## Working with Materials

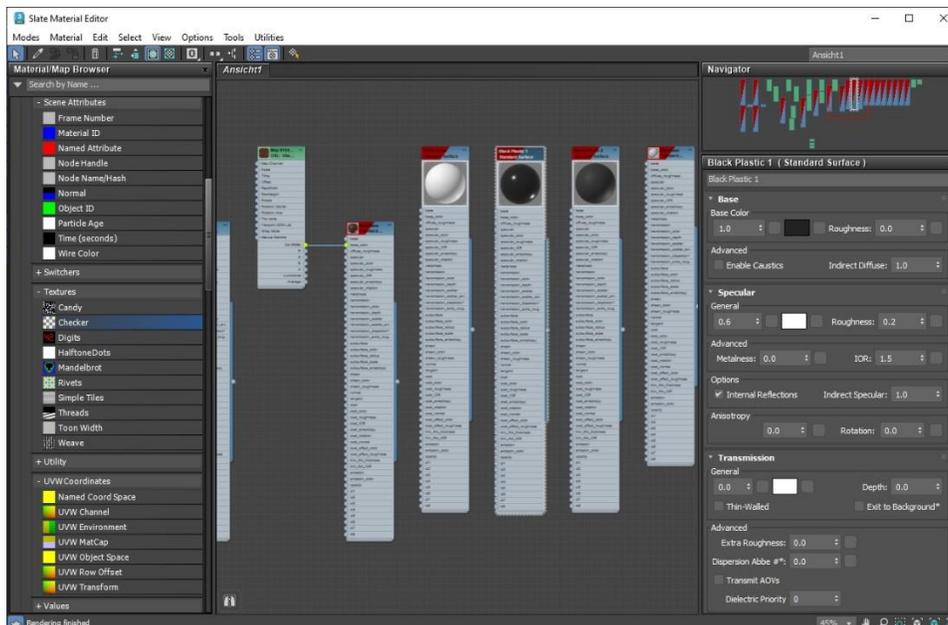
Begin by selecting the materials from each object. There are already materials in the view1 workspace: one is the OSL shader for the HDRI Environment, and the others are for the background.

### Editing Material Properties

With the materials converted, I can begin editing the materials that are assigned to each object. Here, I need to determine how detailed the materials need to be. While I want the scene to look realistic, I have a very specific look that I'm aiming for, and I want all the materials to work with the Arnold Renderer in Arnold Compliant mode. This means only compatible materials and maps.

I can use the eyedropper in the Material Editor to pick the material from each object, then arrange the materials horizontally within the view1 work area. With the materials organized, I can edit each to look the way I want them to. These are all Arnold Standard Surface materials,

and the editing that I'm doing is going to be fairly minimal, compared to creating complex materials using multiple texture maps and mapping coordinates.



*THE SLATE MATERIAL EDITOR SHOWING THE THREE MATERIALS ASSIGNED TO THE PARTS OF THE ASSEMBLY.*

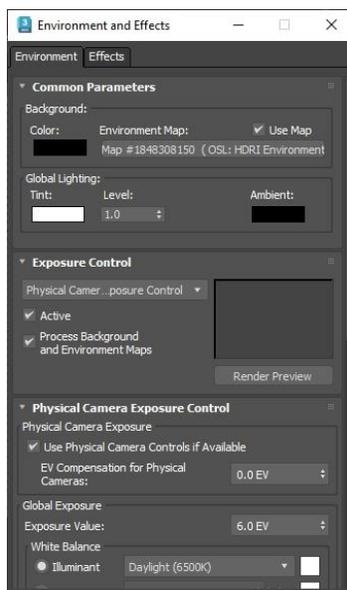
## Rendering with Arnold

Now that I've animated the camera and edited the materials, I'm ready to set up and render the scene. When rendering a final sequence, there are certain things that are important keep in mind.

The assembly should be in some kind of environment, but what that environment consists of is entirely up to you. It could be as simple as creating a floor or a light box; or, you can build an elaborate environment for your animated assembly to be in. For instance, if you're showing the animation of an automotive robot, you might build an assembly line, to show the robot in its true environment.

When you set up your environment, you need to configure the lighting. Lighting is critical! You can do everything right, but if your lighting is not good, then your rendering will not be good. You don't have to be a lighting expert—you just need to have lighting that's well balanced. You can even use the scene set up the way I have it here, with an OSL HDRI Environment shader that will provide easy, realistic lighting.

Next, the scene exposure must be set properly. If the exposure is not set correctly, you could overexpose or under expose the scene. One of the added benefits of using a predefined stage to import the assembly into is that the exposure can be preset to match the lighting in the scene. The scene uses the Physical Camera Exposure Control, and the exposure value is set in the camera's Exposure rollout.

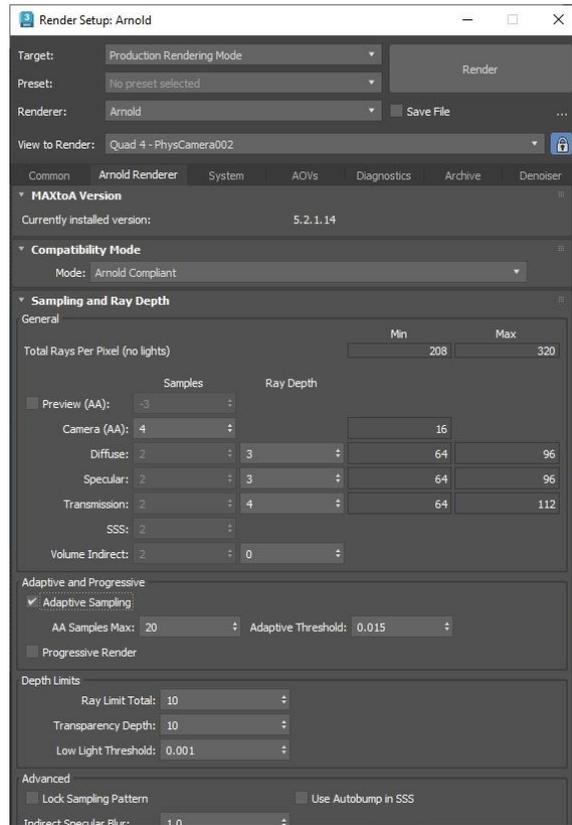


*THE ENVIRONMENT AND EFFECTS DIALOG WITH THE EXPOSURE CONTROL SET TO PHYSICAL CAMERA EXPOSURE CONTROL.*

## Configuring Arnold

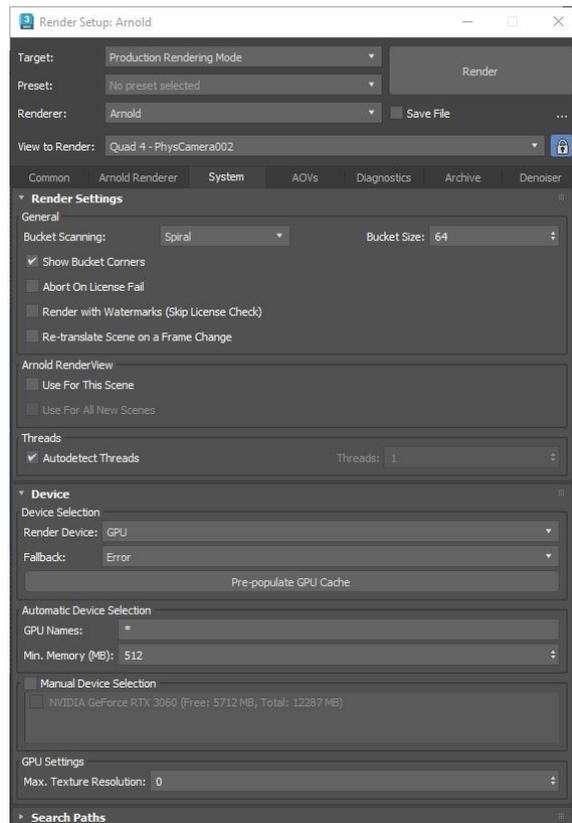
Once everything is set properly, it's time to configure the rendering parameters. Part of setting up the rendering parameters is configuring Arnold. Thankfully, Arnold is an easy renderer to configure. Depending on the level of output quality you need, you can adjust the **Samples** and **Ray Depth** in the **General** group box. The higher the values, the higher the quality and the longer it will take to render. I generally start out with low settings to make sure that everything is going to work, then I increase settings based on the type of lighting in the scene.

For a scene like this where there are not many specular reflections or transparent objects, I'll adjust the **Diffuse** Samples and Ray Depth, along with the **Camera Antialiasing**. To help speed things up a little bit, I also turn ON **Adaptive Sampling**. This uses a threshold value to determine what parts of the scene get more sampling than others.



*THE RENDER SETUP DIALOG WITH MY STARTING ARNOLD CONFIGURATION.*

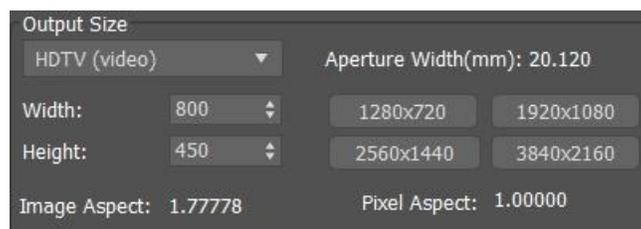
I'm using the Arnold renderer in Arnold compliant mode, which will allow me to speed up rendering considerably by letting Arnold use the graphics hardware in my computer. This is done on the System Tab / Device Rollout by setting the Render Device to GPU.



*THE RENDER DEVICE SET TO GPU TO SPEED UP RENDERING.*

## Output Size and File Type

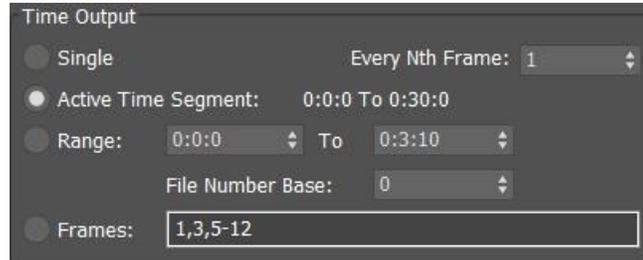
Determining the size of the rendered image should be done ahead of time. This is because the aspect ratio of the final rendered image will change what you see through the camera lens. So, you want to set that up as soon as you can. For this scene, I'm using the **HDTV** formatted **Output Size** and rendering to **800 x 450** image resolution. This will be a low-resolution first pass to make sure everything looks good. If I like the way this animation renders, then I'll increase the output size for a final render.



*THE OUTPUT SIZE OPTIONS CONFIGURED FOR HDTV.*

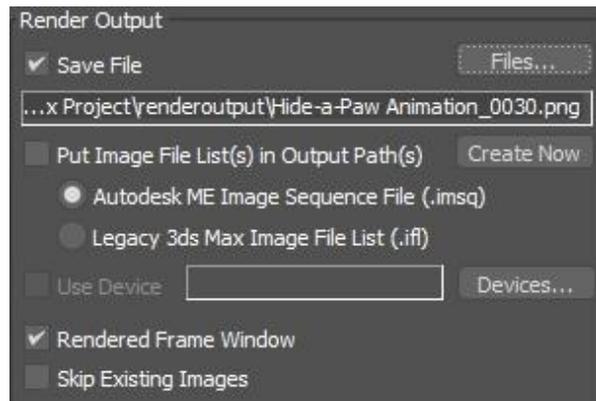
Then, you need to determine the frames to render. Are you going to render the entire sequence, or are you just going to render a few frames? For this animation, I'll render the entire active time

segment, rendering every frame. I can choose to render every other frame or even every fourth or fifth frame, if I want to speed up rendering time.



*THE OUTPUT TIME OPTIONS SET TO ACTIVE TIME SEGMENT, RENDERING EVERY FRAME.*

Finally, what image format will you need to use? Are you going to convert the sequence directly into an animation video file, or will the sequence be edited later? If the sequence is going to be taken into a compositing program, like Autodesk Composite, what image components do you need for compositing? Once you have determined the image format, you are ready to render the animation. For this animation, I'll use PNG files to maintain quality, and I'll open the sequence in 3ds Max's ram player to save it to an AVI file.



*THE RENDER OUTPUT SETTINGS CONFIGURED TO RENDER A SEQUENCE OF PNG FILES.*

Once I click **Render**, the animation will begin rendering, starting with the first frame in the current frame range. The speed of the rendering depends entirely on the speed of the computer, the graphics card used, and whether you are able to distribute the rendering of each frame.



Once the rendering is complete, you will have a sequence of PNG file that you can convert to an AVI file or import into a video editing or compositing program for further work.